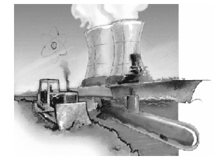
# Mixed Waste Treatment Using the ChemChar Thermolytic Detoxification Technique



**Developer: Mirage Systems, Inc.**
**Contract Number: DE-AR21-95MC31188**
**Crosscutting Area: N/A**

Mixed Waste FOCUS AREA

## Problem:

Effective treatment of low-level mixed wastes is a problem faced by multiple DOE facilities. A variety of waste mixtures are often contained in differing matrices, such as soils, sludges, and in aqueous solutions. The wide range of waste types and matrices increases the difficulty of effective treatment. Land filling, incineration, and long-term storage have been traditional disposal alternatives, but regulatory and stakeholder restrictions either prevent their use or prohibitively increase the cost of their use.

## Solution:

Develop a broadly applicable technique for the safe and efficient treatment of diverse hazardous and mixed wastes in a variety of forms (e.g., solids, liquids, sludges, and soils). The ChemChar process is a thermolytic detoxification technology which dissociates volatile organics by treating the waste in a thermochemical reactor.

## Benefits:

- Treats mixed waste without producing hazardous byproduct compounds in a secondary waste stream
- Reduced need for off-gas treatment compared to competing technologies, such as plasma arc vitrification, molten salt, and metal melting technologies
- Reduced secondary waste volume
- Projected net cost advantage over competing technologies

## Technology:

The heart of the ChemChar process is a thermolytic detoxification technology which dissociates volatile organics by treating the waste in a thermochemical reactor. Through this process of thermochemical dissociation, hazardous organics are converted within the reactor to a safe, oxidizable gas (gasification). The heavy metals, radioactive constituents, and acid gases are concentrated and collected by the reactor into a solid form for further treatment or disposal. The ChemChar process achieves these results without the production of undesirable by-product compounds such as dioxins and furans.

The waste material is prepared for processing in the thermochemical reactor by mixing it with a fine-grained, devolatilized coal char. The char acts as a physical matrix for the waste material and provides a carbon source needed for the thermochemical reactions. The resulting permeable char/waste mixture, along with a gaseous oxidant such as oxygen or air, provide the basic inputs to the reactor.

The outputs of the reactor are a product gas and a regenerated char. The product gas consists of a combustible component (carbon dioxide, hydrogen, and methane), carbon dioxide, water vapor, and trace volatile organic constituents. The regenerated char retains the radioactive or heavy metal constituents. When alkaline, the char also retains acid gases such as hydrogen chloride.
The thermochemical reactor is the key and unique feature of the ChemChar process. The reactor provides the means to establish a stable and controllable thermochemical reaction zone (TRZ) within the char mixture. The TRZ provides the proper and stable thermochemical environment which

allows dissociative gasification of the volatile organics to occur within the char mixture.

The TRZ is initiated by momentarily applying heat to the char mixture at the output end of the reactor. Once initiated, the TRZ is self-sustaining without external heat, and it migrates against the flow. This counter-current characteristic of the TRZ results in reverse-mode gasification.

After initiation in a continuous feed reactor, a stable TRZ is contained within a limited region of the reactor as the oxidant and char mixture flow continuously through the reactor. Only a small portion of the char is consumed as the mixture passes through the TRZ. Past the TRZ, the char is effectively regenerated and is available for the recycling through the reactor. Char recycling within the reactor can occur a number of times prior to removal for subsequent processing of the adsorbed constituents and spent char.

For mixed waste applications, the output of the reactor is an inert, carbonaceous solid retaining radioactive constituents. The ease of handling this material allows consideration of many available options, such as cement stabilization, for final disposal form.

**Project Conclusion:**

This project was completed at the end of July 1996. At completion the contractor had designed, fabricated, assembled, tested, and operated a continuous laboratory scale (four-inch inner-diameter) reactor system. This system will be used in determining the feasibility of the proposed concept by using surrogate waste to evaluate a design basis for scale up to a pilot-size reactor system.

After shakedown at the contractor's facility, the reactor was shipped to the University of Missouri, Columbia campus, for operational testing. This testing is planned to be conducted by the University of Missouri under a separate contract. It has been contemplated that the contractor may design, construct, and test a pilot-scale unit following successful testing. A cost and engineering evaluation of the system may be performed based on the eventual test results.

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